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(54) **Computer keyboard with dial for entering repetitive data and commands.**

(57) A computer keyboard (10) with a dial (30) for entering repetitive commands and data units into a computer system. It is useful for many computer applications, such as programming and file editing, and affords the user an easier, comfortable and straightforward way of replacing repetitive single-key pressing to send burts of unitary or inverse information to the system. The dial is rotatably mounted on the keyboard frame (12) and has an exposed operating surface (74) which the user may rotate endlessly with just one finger. A rotational transducer (40) senses dial rotation to generate an output signal representing incremental rotation amounts. The keyboard also includes a device (42) for modifying said repeated commands and data units if certain keys (32, 34) are pressed while the dial is being turned.

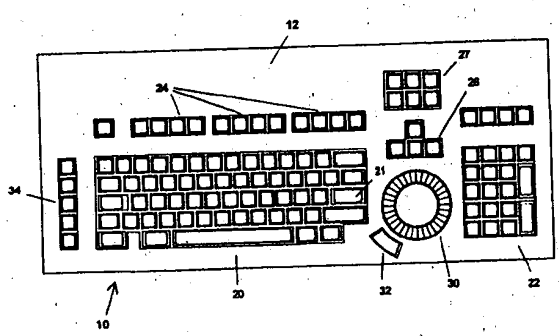

Fig. 1

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Field of the Invention

This invention relates to computer input devices, in particular to keyboards. This invention relates to a new computer keyboard comprising additional non-binary means to improve the working condition of a keyboard operator and accelerate some tasks during operation of computer programmes.

A computer keyboard generally comprises a plurality of keys mounted on a substantially horizontal panel, for entering commands and data units (i.e. characters) into a computer or computer display terminal. Each key is mechanically engaged with a binary switch (i.e., on-off switch) configuring a switch array that is periodically scanned by an electronic circuit to sense the key's status and transmit a corresponding code (called scan code) to a computer system, when a change in the switch array status is detected.

Computer keyboards are used in almost any kind of computer application. Compared to other computer peripherals, computer keyboards have not evolved significantly from the first specimen up to the present state of the art, the only changes being limited to varying key layouts and modifications in key shapes and switching mechanisms. At the time of the present invention, we know of no significant keyboard improvements on operational features or functional enhancements.

Computer keyboards generally include: a first group of alphanumeric keys, used for entering textual, numeric and punctuation data, a second group of keys generally called "control keys", used for controlling some programme functions implemented in most of the contemporary programmes (e.g., HOME, END, PAGE UP, DELETE, etc.), a third group comprising general purpose keys, also known as "function keys" (generally labeled F1, F2, F3, etc.) and a fourth group comprising a set of four keys generally called "arrow keys", generally used to select an item from a list, control a cursor's position, etc. In almost all computer keyboards, a special control key generally labeled "ENTER" is also provided, usually used to communicate the computer that a certain data entry or control task is completed.

Background of the Invention

In normal operation of a computer keyboard, communication between operator and machine comprises tasks that may be grouped in two main groups:

1. Data entry tasks, and
2. Control and command tasks.

In operating many contemporary programmes using a computer keyboard, a significant portion of the tasks included in the second group require intensive use of a certain group of keys, generally in a repetitive fashion, in bursts of repeated activation of a single key. This group of keys mainly comprises the arrow keys, and secondly the control and function keys. Moreover, the repetitive bursts generally appear as a sequence of several bursts of repeated activation of keys that have functions inverse to each other (e.g., PAGE UP / PAGE DOWN, ARROW LEFT / ARROW RIGHT, SPACE FORWARD / BACK SPACE, etc.), usually within a successive approximation to a final state.

This phenomenon may be observed in almost any kind of modern computer application, but mainly in highly interactive applications running in personal computers, like programming, text editing, spreadsheet editing, etc. This is primarily because user interfaces had evolved from command line keyword oriented interfaces to more friendly, visual feedback interfaces controlled by a limited group of keys (or alternatively by another kind of computer input device e.g., a mouse).

For example, in former editing applications, a special screen area was assigned to enter programme commands by typing one or more keywords in it. However, contemporary editing applications tend to use a single key to switch a main menu displaying all available command options, and a particular command can be selected by typing the arrow keys repeatedly until a desired option is highlighted. This interface concept has been almost uniformly adopted in the software industry.

On the other hand, when tasks included in the first group are performed, this phenomenon is not as frequent, because the statistical distribution of alphanumeric keystrokes in most applications is substantially constant so that the probability of repeated keystrokes of the same key is far lower.

We have also noted that repeated activation of the same key in a computer keyboard causes an uncomfortable tension in the operator's hands and wrists that frequently causes fatigue in the operator and results in productivity loss. It is believed that this tension excess is due to the lack of movement compensation between fingers and other parts of the hand when performing repetitive typing. This belief is supported by the fact that this tension does not appear when typing a piece of text for instance, which normally has a relatively uniform letter probability distribution function.

A widely used approach for this problem is the auto-repeat method (generally known as "typematic") implemented in almost all computer keyboard application. The auto-repeat method consists in automatically

repeating the scan code corresponding to the key being pressed at a fixed rate, when the key is kept pressed at least for a pre-determined time period.

Although it represents an improvement, significant enough for it to become widely accepted, this method is not all that comfortable and efficient, mainly because the auto-repeat rate is given by a fixed time reference and hence it is not capable of providing speed and precision simultaneously. That is, a high auto-repeat rate sacrifices precision and a low one gives good precision but is slow. This unavoidable speed-precision trade-off leads the operator back to repetitive typing because usually it is the only way to get enough precision in most tasks. Moreover, throughout a certain computer operation session, different auto-repeat speeds are needed depending on the particular task being performed; this is a requirement not satisfied by the auto-repeat method which lacks this flexibility. Still another disadvantage of the auto-repeat method is that the initial period preceding the auto-repetition function produces some uncertainty in the number of repetitions generated. This is because if the delay is too short it may produce undesired keystrokes, and if it is too large, it produces an uncertainty about the instant in which the repetition will begin, reducing the chances of precise control even more.

This accumulation of effects leads average keyboard operators to perform, or at least complete, a lot of operations with repetitive typing, since it appears as mentally less distressing although, in the long run, it strains one physically and psychologically, perhaps unconsciously.

Consequently, there is a need of an improved computer keyboard, capable of performing this kind of operations more efficiently, to improve the work conditions of a computer keyboard operator and enhance productivity.

Disclosure of the Invention

It is a basic object of the present invention to improve the work condition of a computer keyboard operator, replacing vertical up and down finger and hand movements (due to repetitive typing) with a more ergonomic and comfortable movement.

Another object of the present invention is to reduce time spent in some tasks while operating a computer programme with a keyboard.

Another basic object of the present invention is to improve the user interface provided by a computer keyboard, by enhancing its command and data entering capabilities.

Another object of the present invention is to reduce the risk of hand, finger and wrist diseases associated with computer keyboard operation, by providing an improved and more ergonomic way of entering repetitive commands and data.

Another object of the present invention is to provide an improved keyboard having all the features stated above that can be manufactured at a substantially low incremental cost.

Another object of the present invention is to provide a computer keyboard having all the features stated above but substantially maintaining the format and operating characteristics of a conventional keyboard.

According to the invention, the improved keyboard having the features set forth above comprises a conventional keyboard in which the fixed time reference of the auto-repeat function has been replaced by a manually generated timing signal through operation of a dial engaged with a rotation transducer. The dial is rotatably mounted with its rotation axis substantially perpendicular to the keyboard plane, exposing one of its surfaces so as to be engagable by a finger of an operator's hand at a number of radial positions spaced from its centre, so that the sensitivity of the device, i.e., response per finger travel distance, depends on the radial position contacted. In other words, the farther the radial position of finger contact from the centre of the dial, the less sensitive the response to a given amount of finger travel.

A pulsing signal is derived from the output of the rotation transducer representing the angular speed of the dial measured in predetermined incremental angular units, plus an additional binary signal giving the sign of the rotation (i.e., clockwise or counterclockwise). The dial can be rotated endlessly and operated in combination with one or more keys for entering bursts of repeated commands and data units into a computer, the number of repetitions as well as the repetition rate being under tight control of the operator. Furthermore, the dial can be rotated back and forth to switch between two scan codes associated with each key, so that the scan code generated in repetition mode is dependent on the dial rotation direction, enabling fast switching between two different commands associated with a single key (useful for commands having inverse responses to each other).

Auxiliary keys may be used in combination with the dial for performing special functions. A pair of default scan codes can be generated when the dial is rotated without pressing any key, for fast issuing of very frequently used commands.

Brief Description of the Drawings

Figure **1** is a plan view of a personal computer keyboard incorporating a dial and other features according to a preferred embodiment of the invention.

Figure **2** is an enlarged perspective view of a portion of the keyboard of figure **1** including the dial.

Figure **3** is a cross-sectional view of the dial according to an embodiment of the invention.

Figure **4** is a time-chart showing binary signal waveforms and phase relationships at the output of the transducer associated with the dial.

Figure **5** is a block diagram of the keyboard of the invention, including the dial and associated transducer hardware according to a first embodiment of the invention.

Figure **6** is a flow-chart illustrating a programme routine embodying the operational aspects of the keyboard of the invention.

Figure **7** is a block diagram of the keyboard of the invention, including the dial and associated transducer hardware according to a second embodiment of the invention.

Figure **8** is a schematic representation of a possible trajectory of a finger point of contact through a plurality of radial positions.

Figure **9** is a plan view of the keyboard portion of figure **2**, representing a particular arrangement according to a preferred embodiment of the invention.

Detailed Description of Embodiments

Figure **1** shows a preferred embodiment of a keyboard **10** according to the invention, based on a typical key layout widely used in PC keyboards. In particular, the keyboard **10** includes keyboard supporting frame **12**, a main alphanumeric pad **20**, a numeric panel **22** located to the right of panel **20**, generic function-key panel **24** placed above the main panel **20**, arrow key panel **26** and control key panel **27** placed between the main panel **20** and the numeric panel **22**.

According to the present invention, the keyboard **10** includes a rotatable dial **30** mounted on the keyboard frame **12** with its rotation axis **29** oriented substantially perpendicular to the plane defined by the key panels, which may freely rotate with relatively little friction. In the preferred embodiment, the keyboard **10** also comprises an auxiliary key **32** for switching a pair of scan codes associated with very frequently used commands, specially shaped to be operated by the thumb of the operator's hand in a way that both dial **30** and key **32** can be simultaneously operated with the thumb and fingers of the same (e.g. right) hand. Also shown in figure **1** is an extra key set comprising auxiliary keys **34** used for switching special scan codes associated with special commands or functions. In the preferred embodiment, this set of keys **34** is placed on the left-hand side of the keyboard **10** so as to be operable by the other (left) hand of an operator.

Figure **2** shows a more detailed view of the dial **30** and the auxiliary keys **32**, mounted on the keyboard frame **12** and surrounded by the main key panel **20**, the arrow keys panel **26** and the numeric key panel **22**, thus configuring an advantageous arrangement as will be explained further on herein. As illustrated in figure **3**, the dial **30** is mounted over a stepped opening **31** in the top **13** of the keyboard housing. The opening **31** has a concentric outer step where dial **30** just fits in so as to keep dust from getting inside the keyboard housing **10**.

Figure **3** also shows a preferred embodiment of the dial and rotational transducer advantageously using a single piece of material and taking advantage of computer keyboard structures well known in the art. The dial **30** may be manufactured as a knob **50** shaped with an elevated top flat portion **70** and a sloped conical peripherical portion **74** so as to approximately fit in a human palm for easy and reliable manipulation of the dial **30** with any or all fingers of the right hand of the operator. Since the conical portion **74** has been designed to enable precise and slow operation of the dial, it has proven useful to use a rugged surface or a plurality of protruding elements as radial strips or the like. However, for the central portion **70**, a polished surface (e.g., acrylic) is preferable, since it allows a good tracking and at the same time provides a smooth and uniform contact surface.

Inside, the dial **30** comprises a shaft **52** posted on the centre of internal surface **54** of the knob part. The shaft **52** is mounted on a bushing **56**, fixed to the bottom **62** of keyboard housing **10**. The dial mounting preferably includes a circumpherencial recess **58** in the shaft **56** which receives a resilient latch **59** so that together they hold the dial **30** in place on the keyboard. This mountage has the advantages that, for one, it is easy to insert and remove, enabling nearly instant mounting in the keyboard manufacture and assembly process and, furthermore, features low static friction which gives it just the right resistance so that it can be easily and precisely turned by the operator with hardly any effort.

Going back to the shape of the dial **30**, the conical portion **74** folds back at the outer edge and then downwards at a right angle to form a lower cylindrical skirt **57** which is supported above a printed circuit board **66**. The bottom edge of the skirt **57** is slotted so as to form a continuous line of rectangular openings all the way round the skirt **57**.

As is conventional, this circuit board **66** houses the electronics which interface the computer keyboard **10** with a port of the computer system. According to the preferred embodiment of this invention, the circuit board **66** also supports a pair of opto-couplers **68** (only one of which can be seen in figure **3**) for sensing dial rotation. More precisely, the opto-couplers **68** are placed on the board **66** relative to the opening **31** so that the cylindrical skirt **56** fits into opto-coupler gaps. Thus, any rotation of the dial **30** results in passage of openings through the opto-coupler gaps. Each of the opto-couplers **68** issue pulse trains contains information regarding direction, rate of turn and incremental angle of turn.

Therefore, the slotted skirt **57** together with opto-couplers **68** form a rotational transducer **40** represented in the block diagram of figure **5**. As the dial **30** is rotated, the opto-couplers **68** generate a pair of signals **X1-X2** representing signed incremental rotational movement of dial **30**. The opto-couplers **68** are mounted on printed circuit board **66**, for instance by soldering, at two angularly spaced locations relative to the dial shaft **52** so as to generate synchronous quadrature pulse signals according to a widely known rotation transducer technique displayed in figure **4**.

Every quarter-cycle of signals **X1-X2** represents an elementary angle **DA** according to a predetermined resolution. As can be seen in figure **4**, the variation of the signal status taken together in each quarter-cycle gives all the motion information. A change in the status of signals **X1-X2** at two different points in time defines a transition and provides motion direction information as summarized in the following **Table 1**.

TABLE 1

$X1_n$, $X2_n$	$X1_{n+1}$, $X2_{n+1}$	Motion Direction
00	00	0
00	01	-1
00	10	+1
00	11	x
01	00	+1
01	01	0
01	10	x
01	11	-1
10	00	-1
10	01	x
10	10	0
10	11	+1
11	00	x
11	01	+1
11	10	-1
11	11	0

In **Table I**, the column marked "$X1_n$, $X2_n$" represents the signal status prior to detection of the transition and the column marked "$X1_{n+1}$, $X2_{n+1}$" represents the status after transition. The third column shows the incremental signed value of the motion detected. Transitions marked with an "**x**" are not possible in the scheme of figure **5** and may be used as an error signal indicating a transducer malfunction.

Figure **5** shows a block diagram of a preferred embodiment of the electronic circuit onboard the keyboard **10**. As shown in figure **5**, signals **X1-X2** are read by parallel inputs **P0** and **P1** of logic circuit means **42**, which processes the signals to detect the dial rotation according to **Table I** and calculate the angular units rotated according to a predetermined resolution. The logic circuit **42** derives an internal timing signal for each rotation angular unit detected for triggering transmission of the corresponding scan codes when a key is pressed (or the default scan-codes if no key is pressed). The logic circuit **42** derives an additional internal binary signal indicative of the sign of the rotation, for selecting the corresponding scan code from the set of scan codes associated with each key according to the dial rotation direction, as explained further on herein.

In the preferred embodiment, the logic circuit **42** is the same means used for scanning key array **44** of keyboard **10**, since it only requires the availability of input ports **P0** and **P1** and some extra programming to

include the transition detection routines and link them to the already available scan code generating means and routines (naturally built into the circuit **42**). Circuit **42** can be embodied by means of a microcomputer such as the Motorola 6809 with associated hardware for scanning the key array **44** and transmitting scan codes to the computer system. It will be apparent to those skilled in the art that all accessory elements and means are well known in the industry and are common practice in manufacturing today's computer keyboards. For instance, the key array **44** of figure **5** represents the set of keys of a conventional keyboard, including main alphanumeric panel **20**, numeric panel **22**, generic function keys panel **24**, arrow keys panel **26** and control keys panel **27**. Arrays **44** and **34** are cross-scanned by respective lines connected to generic input ports **P2** through **Pn** of circuit means **42**.

Figure **6** is a flow diagram of the functions carried out by circuit means **42**. The part of the diagram inside the dotted line shows a method similar to that used in a conventional keyboard, the only difference being that in a conventional keyboard, only a single scan code is associated with each key, generated when a key status change is detected. In the keyboard **10** of the invention, however, each key is associated with more than one scan code, the additional scan codes being generated by the dial rotation and depending on the dial rotation direction. The scan code generated when a key is pressed without rotating the dial is called "static scan code", while the additional scan codes defined for the corresponding dial rotation directions are called "dynamic scan codes". Each time a key array **44** status change is detected, circuit means **42** looks up in a table the new scan codes according to the new activation status of key array **44** (keys pressed or released) and fills in a one-dimensional data structure called "scan code vector". When a key is pressed from a released position, circuit means **42** generates the corresponding static scan code. If the key is held in an active position and the dial is rotated, circuit means **42** generates repeatedly the dynamic scan code present in the scan code vector, according to the dial rotation direction and upon detection of each incremental angular unit rotated by the dial.

Table **2** gives an example of a possible scan code assignment table to illustrate this principle.

TABLE 2

Key Label	Static Scan Code	Dynamic Scan Codes	
		(-)	(+)
TAB	21	33	21
SPACE	6B	7D	6B
AUX 1	-	9C	B4

If the keyboard in which the invention is to be practiced is a double code keyboard (i.e., a keyboard that generates a first scan code when a key is pressed and a second scan code when the key is released) as is the case for example of contemporary "PC" keyboards, almost the same scheme may be implemented, the difference being that two scan codes are generated for each dial rotation transducer transition detected, with a suitable delay in between, so as to simulate repeated keystrokes of the same key while maintaining full compatibility with existing applications.

Moreover, Table **2** can be further enhanced to contain not only single scan codes, but a combination of them, so as to simulate repeated keystrokes of a key combination or macro rather than of a single key. For example, "TAB" and "SHIFT + TAB" can be assigned to a certain key of group **34**, respectively as the positive and negative dynamic scan codes, so as to use the dial as an option selector in applications that use these key combinations for that purpose.

Although Table **2** has been dimensioned to contain scan code information for each key (i.e., the static scan code and both dynamic scan codes), it may be enhanced to contain additional key-specific information. For example, for some particular keys, a different effective resolution (i.e., the number of dynamic scan codes generated in a complete turn of the dial) may be desirable so as to reduce the dial's sensibility for that particular key. An example of this case is the "PAGE UP" - "PAGE DOWN" function, in which a user needs a certain time period between two successive commands so as to recognize the successive displayed images while browsing a certain file or document. This can be done by providing an additional column in Table **2** containing a number representing a different angular unit value for each key.

If internal skirt **57** is dimensioned to allocate for example 20 slots, a wide range of repetition rates may be easily obtained, from nearly nought (by operating the dial from its periphery) to approximately 200 Hz (by sliding the fingers towards the dial's centre to gain rotational speed). This is illustrated in fig. **8** which sketches a clockwise rotation **A1** during a repetition operation. An example of a finger point of contact

trajectory has been represented as curve **T** in figure **8**. As may be seen in fig. **8**, to generate an approximately complete turn, just a relatively small amount of finger travel is needed by turning the dial, first sliding the finger from starting point **S** towards the centre of the dial and then sliding the finger back towards the ending point **E** at the dial periphery. In this elementary operation performed very frequently while using the dial, since the point of contact evolves through a number of radial positions, from radial position **r2** to radial position **r1** and then back again to radial position **r2**, different angular speeds are obtained as the dial rotates a greater or lower number of angular units **AU** in a given time interval, thereby varying the repetition speed and the perceived effective resolution for a given point of contact travel. The result is that the operator can tightly control a certain repetition operation with both speed and precision at the same time, which in the long run results in a comfortably and efficient operation of the computer.

Moreover, if a wider repetition rate range is wished, the effective resolution may be varied dynamically to produce an acceleration effect. In other words, the function relating the number of rotation transducer transitions detected in a certain time period to the effective repetition timing signal cycles generated in the same time period need not be linear, so that a higher number of transitions detected produces an even higher effective repetition timing signal cycles, widening the effective repetition timing signal range. This can be done for example by dynamically altering the instantaneous angular unit as a function of the rotating speed of dial **30**. The processing needed to perform the acceleration effect may be done by circuit means **42**, using routines widely known in the art. An additional advantage of implementing the acceleration effect is that it lowers the number of slots of skirt **57** and tolerances requirements in mounting of opto-couplers **68** and dial **30**, while still allowing a relatively wide repetition rate range.

In a second embodiment of the invention, the processing means that process the signals generated by the dial rotation transducer and perform the disclosed functions may be inside the computer system, as shown in figure **7**. The advantage of this alternative embodiment is that the scan-code table may reside in the computer's memory and hence may be easily configurable for user customization. On the other hand, the disadvantage is that it is not independent of the computer operating system running in the computer and may not guarantee immediate 100% compatibility since modifications need to be introduced at operating system level so as to simulate repeated keystrokes upon dial rotation, in a way that it is transparent to any application programme running in the computer. On the other hand, in the first embodiment, the signals generated by the keyboard **10** when the dial is rotated are always identical to those generated by the effective activation of the physical keys, so that the keyboard of the first embodiment of the invention is fully transparent to any programme running in the computer, even to the operating system itself.

In the preferred embodiment, the horizontal arrow key scan codes are assigned as respective default dynamic scan codes, and the vertical arrow key scan codes are assigned as respective dynamic scan codes of auxiliary key **32**. With these assignments and since dial **30** and auxiliary key **32** are simultaneously operable, the combination of both elements behaves in some applications as a two-dimensional, one-dimension-at-a-time cursor control device of an extremely wide speed range and of unlimited trajectory extent due to the operational characteristics of the dial mentioned hereinbefore. For example, when editing a text file in a contemporary word processing application, activation of the right or left arrow keys causes a text cursor to shift from one character position to the next, respectively in a forward or backward direction. At that point, the dial **30** can be used as a right-left cursor control device, capable of traveling without limit and continuously over the text file with significantly little effort and hand movement. Furthermore, if the auxiliary key **32** is pressed, the dial **30** can be used as an up-down cursor control device, shifting the cursor across successive lines of text allowing to reach any part of the text file in the same way.

Moreover, if both dial **30** and auxiliary key **32** are placed on the keyboard panel to the right of the ENTER key **21**, as shown in figures **1** and **8**, the resulting arrangement inside the dotted line in figure **8** allows a fast, relaxed and efficient programme control in many of contemporary computer applications, since most of them are based on the arrow keys and the ENTER key to control a significant part of the programme flow. For example, in an application based in a pull-down menu structure, the dial may be first used to select a sub-menu by generating the horizontal arrow keys (default dynamic scan codes), and further used to select a certain command within the selected sub-menu by simultaneously pressing auxiliary key **32** to generate the vertical arrow key dynamic scan codes. When the desired command is reached, the ENTER key may be pressed to complete the selection. In this way, the dial **30** combined with auxiliary key **32** and the ENTER key work together as a programme control device, eliminating the need for repeatedly pressing the arrow keys to navigate through the menu tree nodes and branches.

Furthermore, auxiliary keys **34** may be advantageously used to issue pairs of commands frequently used in a repetitive fashion and that produce opposite effects to each other. For example, if the "Page Up" and "Page Down" key scan codes are assigned to one of auxiliary keys **34** as its respective dynamic scan

codes, when said key is pressed while the dial is rotated the dial behaves in many applications as a rotary scrolling device, very useful for browsing for example a long text file or data base file at the computer screen, allowing inspection of the file in a forward or backward direction efficiently and comfortably.

Table **3** is an example of how scan codes may be assigned, thus summarising this disclosure.

TABLE 3

Pressed Key	**Dynamic Scan Codes**	
	Counterclockwise	Clockwise
None (Default)	Left Arrow	Right Arrow
Auxiliary Key **32**	Up Arrow	Down Arrow
Aux. Key **34** (1)	Page Up	Page Down
Aux. Key **34** (2)	Space Bar	Delete Character
Aux. Key **34** (3)	Shift + Tab	Tab
Aux. Key **34** (4)	Gen. Inv. Fn.	Gen. Direct Fn.
Alphanumeric Keys	Back Space	Key Static Code

As another example, the scan codes of "DELETE" and "SPACE" keys may be assigned to another key in the set **34** as its respective dynamic scan codes, to let entire strings of characters to be rubbed out as the dial is turned in a clockwise direction and otherwise inserting space characters when the dial is rotated in a counter-clockwise direction.

While the invention has been illustrated and embodied in a keyboard comprising a dial for entering repetitive data and commands to a computer, it is not intended that it should be restricted to the details given, since various modifications and structural changes may be made without departing in any way from the nature of the present invention. Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it to various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention.

Claims

1. A computer keyboard (10) for connection to a computer system for entering commands and data units into said computer system; said keyboard including a plurality of keys (20, 22, 24, 26, 27) mounted in a supporting frame (12), scanning means (42) to sense activation of said keys, processing means (42) to generate said commands and said data units on detecting of a status change of said keys and communication means for transmitting said commands and said data units to said computer system; and characterised by comprising a rotatable dial (30) for manually entering sequences of repeated commands and data units to said computer system, said dial being rotatably mounted in said supporting frame and having a centre (70), a rotation axis (29) passing through said centre and an exposed operating surface (74) engagable by at least one finger of an operator at a plurality of radial positions from said centre so that said dial can be rotated without limit by said at least on finger; rotational transducer means (56, 68) for detecting rotation of said dial and generating an output signal indicative of incremental rotation said dial in pre-defined angular units; means (42) for using said output signal to generate said repeated commands and data units for entry into said computer system upon detection of said incremental rotation angular units, means (42) for modifying said repeated commands and data units by activation of said keys while said dial is rotated by said operator.

2. The keyboard of claim 1, characterised in that said supporting frame is substantially planar; said keyboard including an alphanumeric key panel (20), an arrow key panel (26) and a numeric key panel (22); said dial is mounted with said rotation axis substantially perpendicular to said frame and said dial is located adjacent to at least one of said key panels.

3. The keyboard of claim 2, characterised in that said dial is substantially circular and has a substantially flat circular elevated central portion (70) for ease of operation so as to reach any of said plurality of radial positions on said dial and obtain different rotation speeds of said dial for equal finger travel rates by contacting said dial at different radial positions.

4. The keyboard of claim 3, characterised in that said dial has a sloped substantially conical peripheral portion (74) ergonomically adapted to a human hand to ease operation of said dial.

5. The keyboard of claim 4, characterised by further comprising a plurality of auxiliary keys (32, 34) for switching frequently used commands or data units, at least one of said auxiliary keys (32) being positioned alongside said dial so as to enable simultaneous operation of said dial and said at least one auxiliary keys with a single hand by said operator.

6. The keyboard of claim 5, characterised in that at least one of said auxiliary keys (32) is located adjacent to a left lower quadrant of said circular dial so as to allow operation of said auxiliary key by a thumb of said hand, said auxiliary key having an approximately circular arc shape, said arc being coaxial to said dial.

7. The keyboard of claim 6, characterised by further comprising a printed circuit board (66) including at least a portion of said rotational transducer means including a pair of opto-couplers (68); and characterised in that said dial is shaped like a knob having: a top portion (70) formed by said flat circular elevated central portion and said substantially conical peripheral portion (74) around said central portion, a lower cylindrical skirt (57) extending downwards from said substantially conical peripheral portion and having a bottom edge spaced from said printed circuit board means and a plurality of slots in said bottom edge, said opto-couplers being positioned on said printed circuit board so that said bottom edge of said lower cylindrical skirt passes through said opto-couplers when said dial is rotated, and a central shaft (52) extending downwards from said central portion, said shaft being engagable rotatably, but axially securable, in a bushing (59) fixed to said supporting frame.

8. The keyboard of claim 7, characterised in that said central shaft has a circumpherential recess (58) and said bushing has a resilient latch (59) positioned to engage in said recess when said shaft is inserted in said bushing so as to retain said knob in place and enable said knob to be swiftly fitted into and removed from said supporting frame.

9. A computer system including a computer keyboard (10) for entering commands for controlling a computer programme running in said computer system and entering data units into said computer programme; said keyboard including a plurality of keys (20, 22, 24, 27) mounted on a supporting frame (12), scanning and processing means (42) to sense activation of said keys to generate said commands and said data units in response thereto and communication means (42) for transmitting said commands and said data units to said computer system; and characterised by including an arrangement for improving and speeding up operation of said programme comprising a rotatable dial (30) for manually entering sequences of repeated commands and data units to said computer system, said dial being rotatably mounted on said supporting frame and having a centre, a rotation axis (59) passing through said centre and an exposed operating surface (74) engagable by at least one finger of a hand of an operator at a plurality of radial positions from said centre so that said dial can be rotated without limit by said at least one finger of said hand; transducer means (57, 68) for detecting rotation of said dial and generating an output signal indicative of incremental rotation of said dial in pre-defined angular units; means (42) for using said output signal to generate said repeated commands and said data units for entry into said computer system upon detection of said incremental angular units; a plurality of keys (26) positioned in proximity to said dial so as to allow easy access of said keys by said fingers of said hand; a plurality of auxiliary keys (32, 34) for switching frequently used commands and data units, at least one (32) of said auxiliary keys being positioned alongside said dial so as to allow simultaneous operation of said dial and said at least one auxiliary key by said operator with a same hand; and means (42) for modifying said repeated commands and data units by activation of said keys while said dial is rotated by said operator.

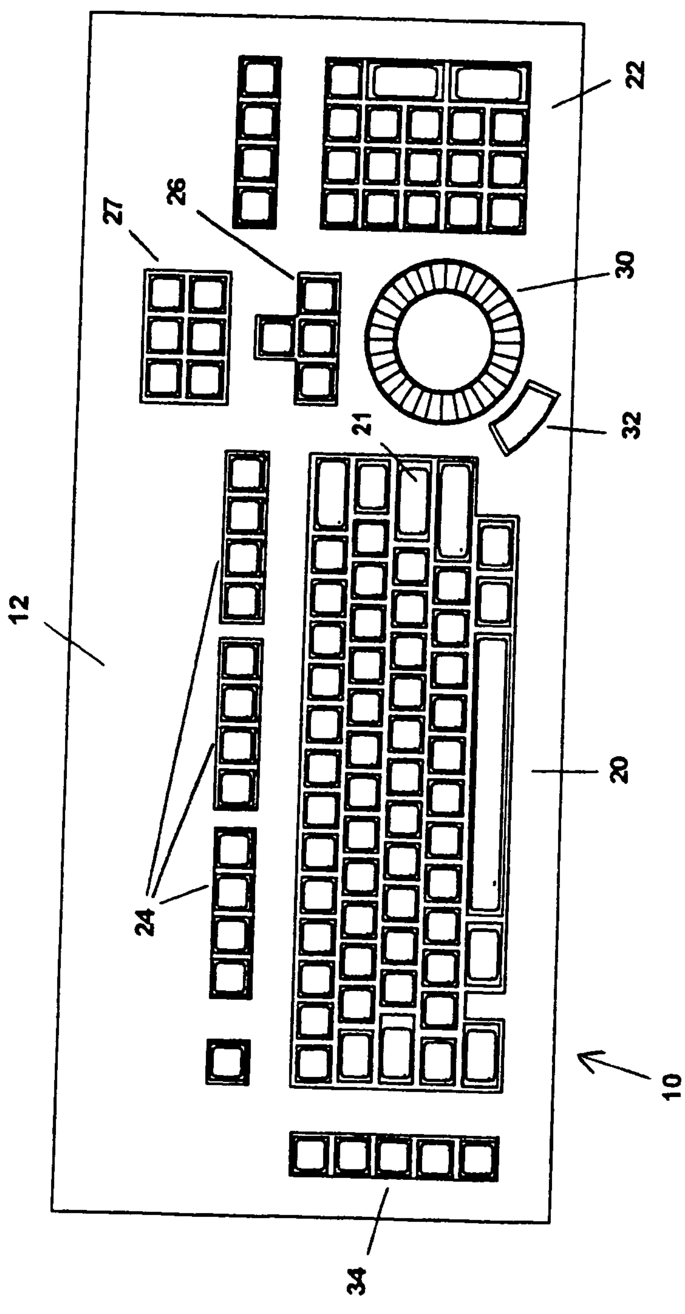

Fig. 1

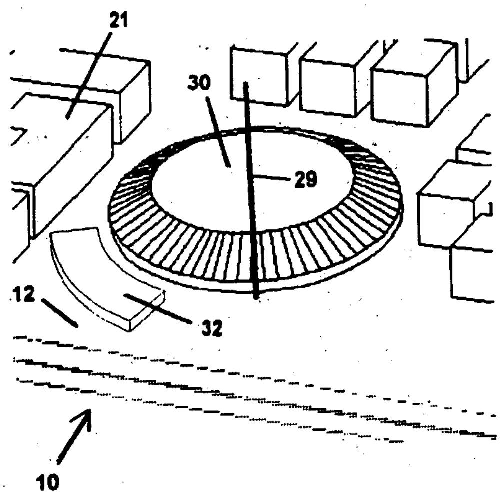

Fig. 2

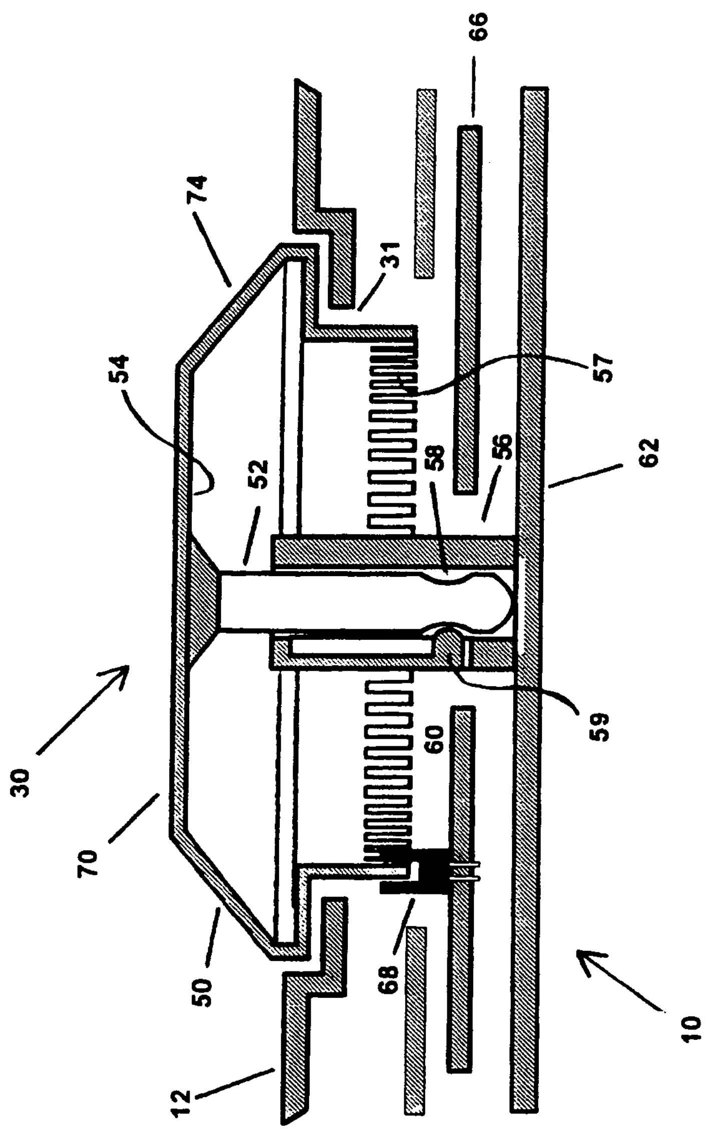

Fig. 3

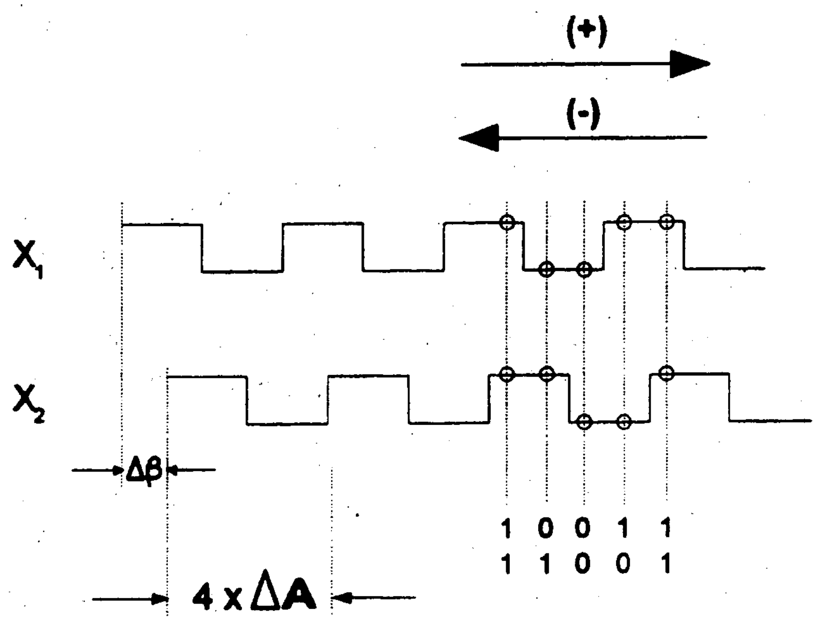

Fig. 4

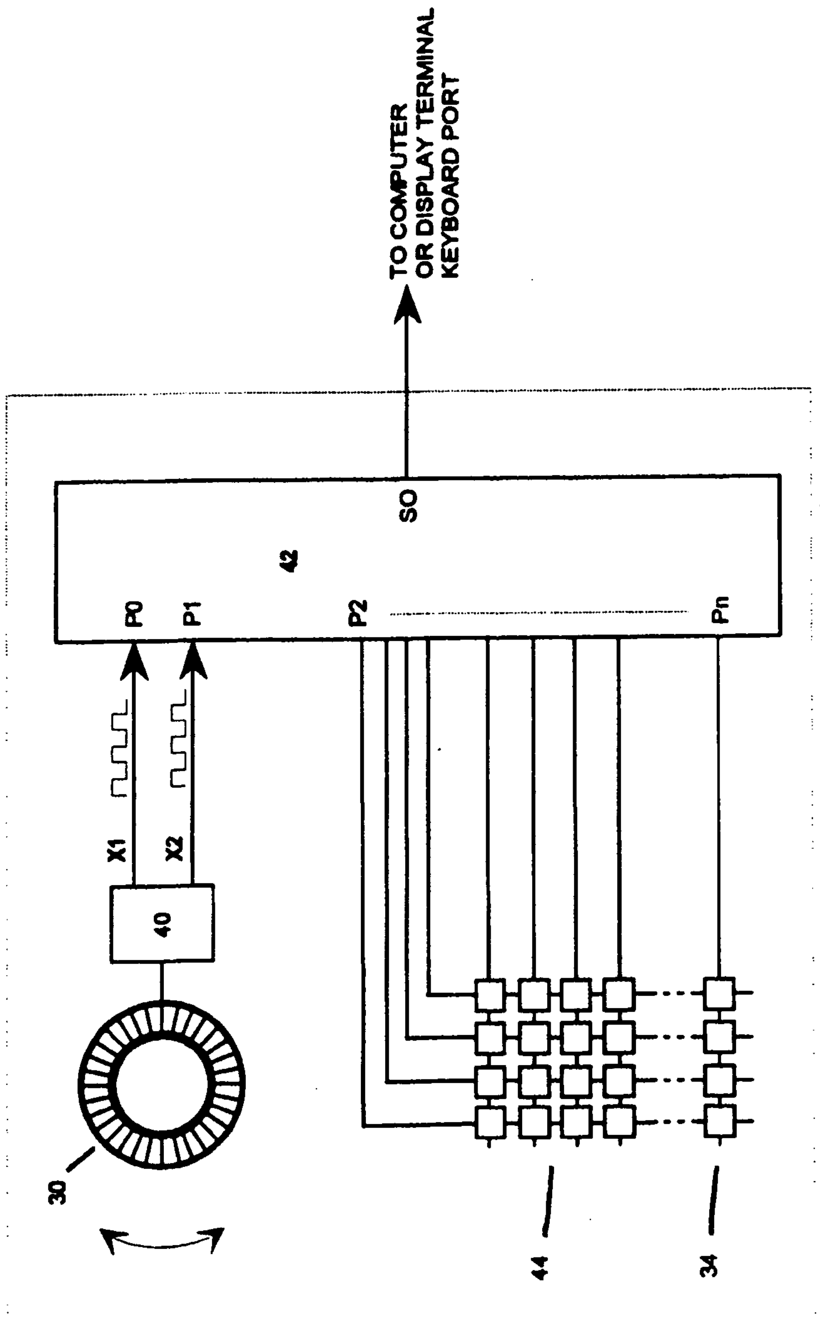
TO COMPUTER
OR DISPLAY TERMINAL
KEYBOARD PORT
SO
42
P0
P1
P2
Pn
X1
X2
40
30
44
34

Fig. 5

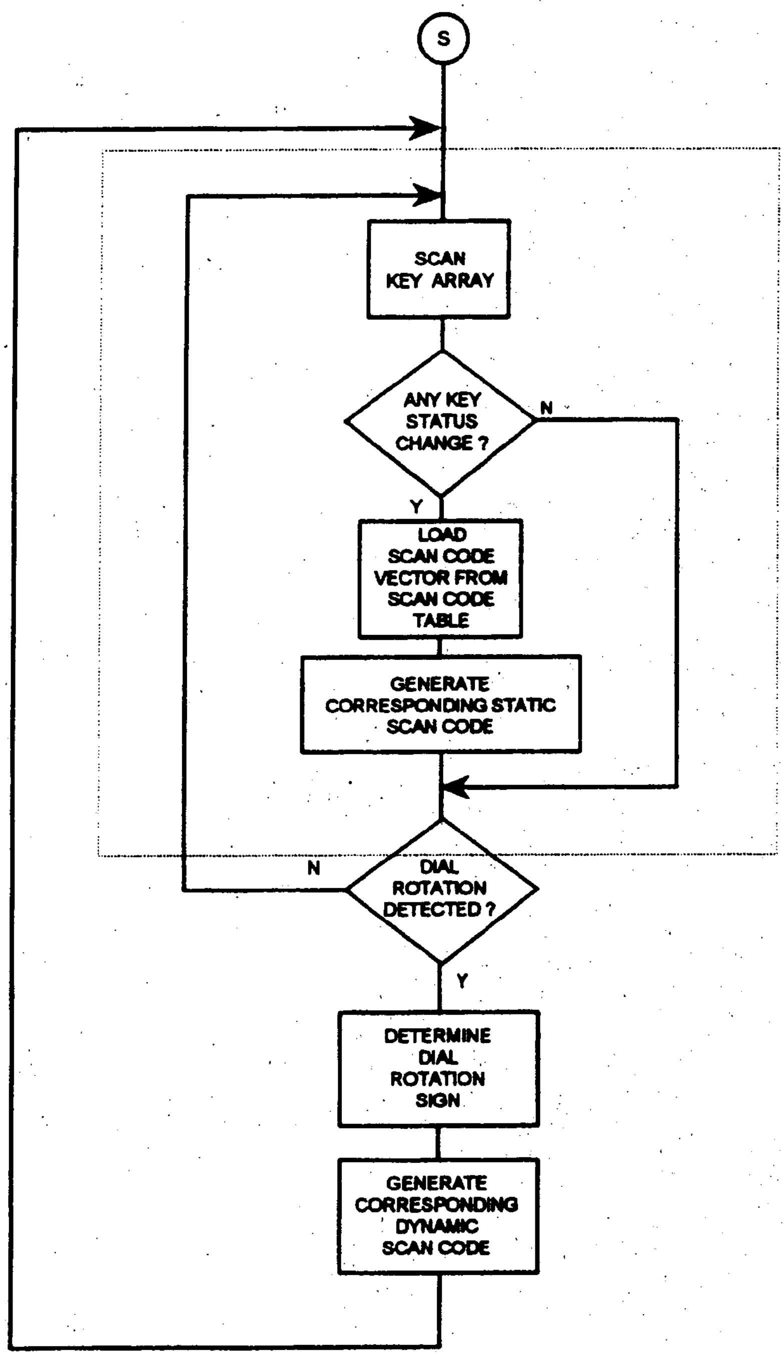
S
SCAN KEY ARRAY
ANY KEY STATUS CHANGE ?
N
Y
LOAD SCAN CODE VECTOR FROM SCAN CODE TABLE
GENERATE CORRESPONDING STATIC SCAN CODE
DIAL ROTATION DETECTED ?
N
Y
DETERMINE DIAL ROTATION SIGN
GENERATE CORRESPONDING DYNAMIC SCAN CODE

Fig. 6

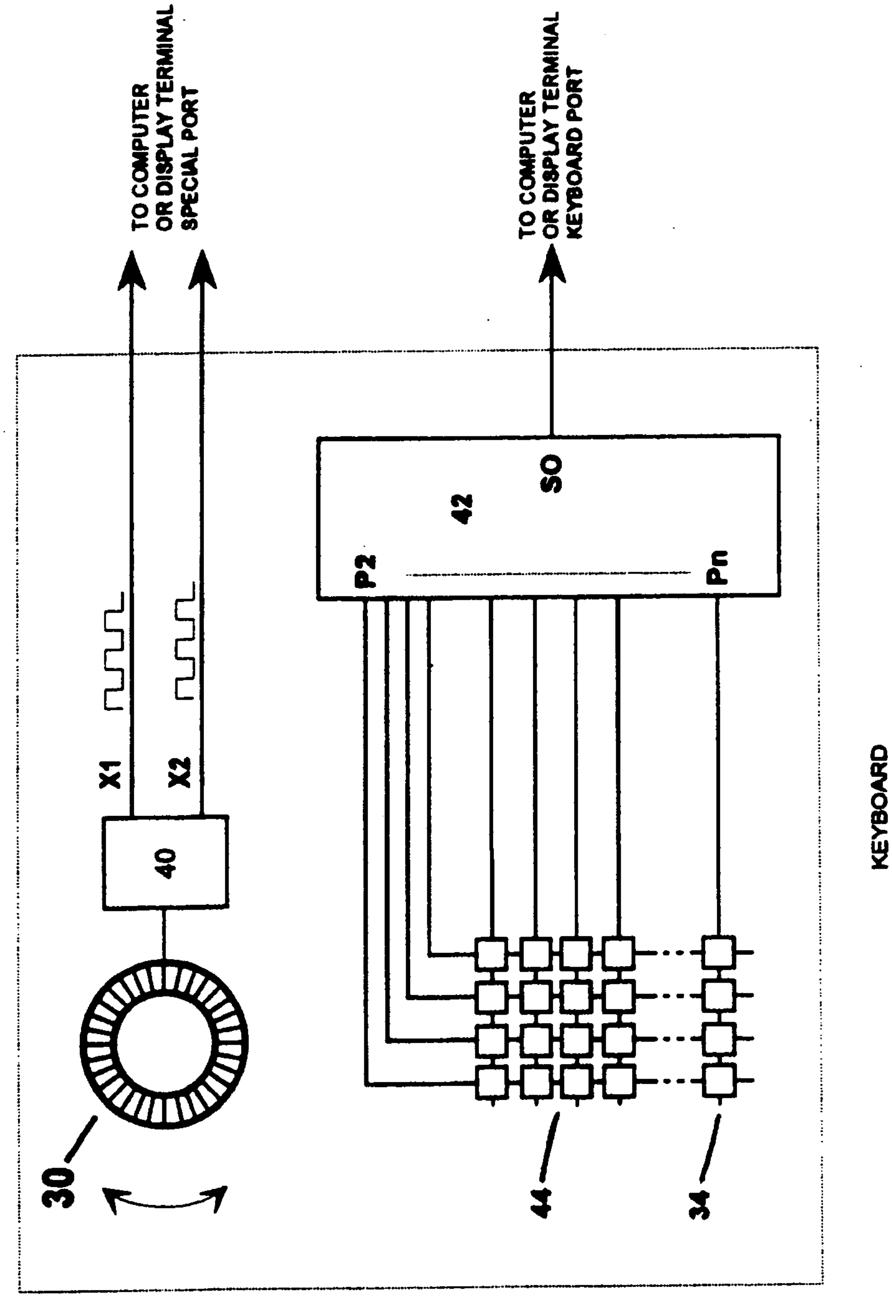
TO COMPUTER
OR DISPLAY TERMINAL
SPECIAL PORT
TO COMPUTER
OR DISPLAY TERMINAL
KEYBOARD PORT
X1
X2
40
42
SO
P2
Pn
30
44
34
KEYBOARD

Fig. 7

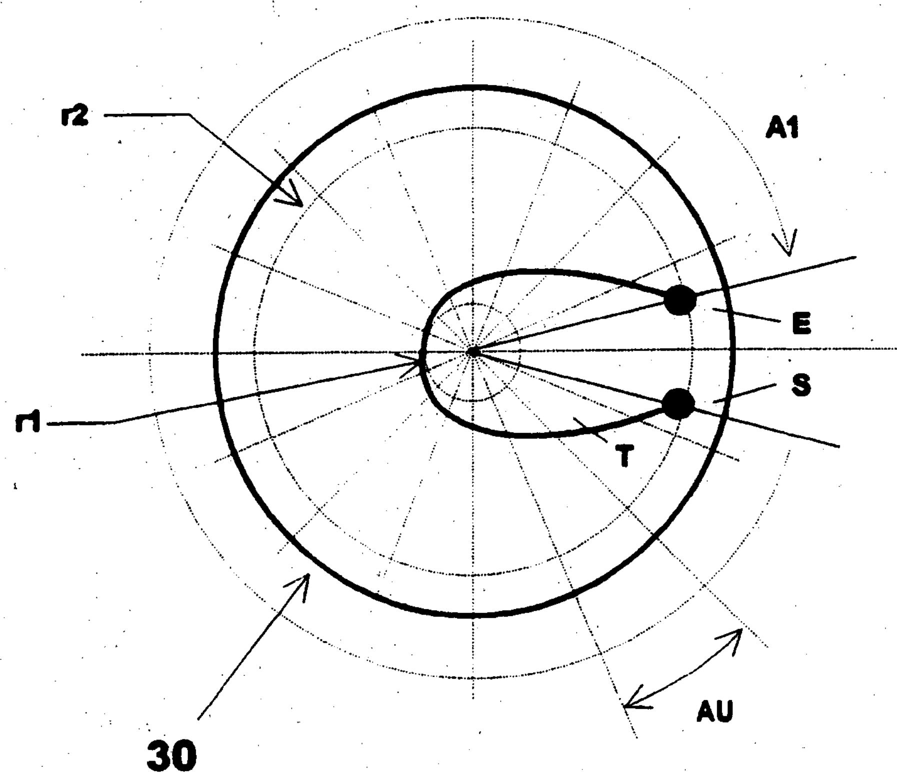

Fig. 8

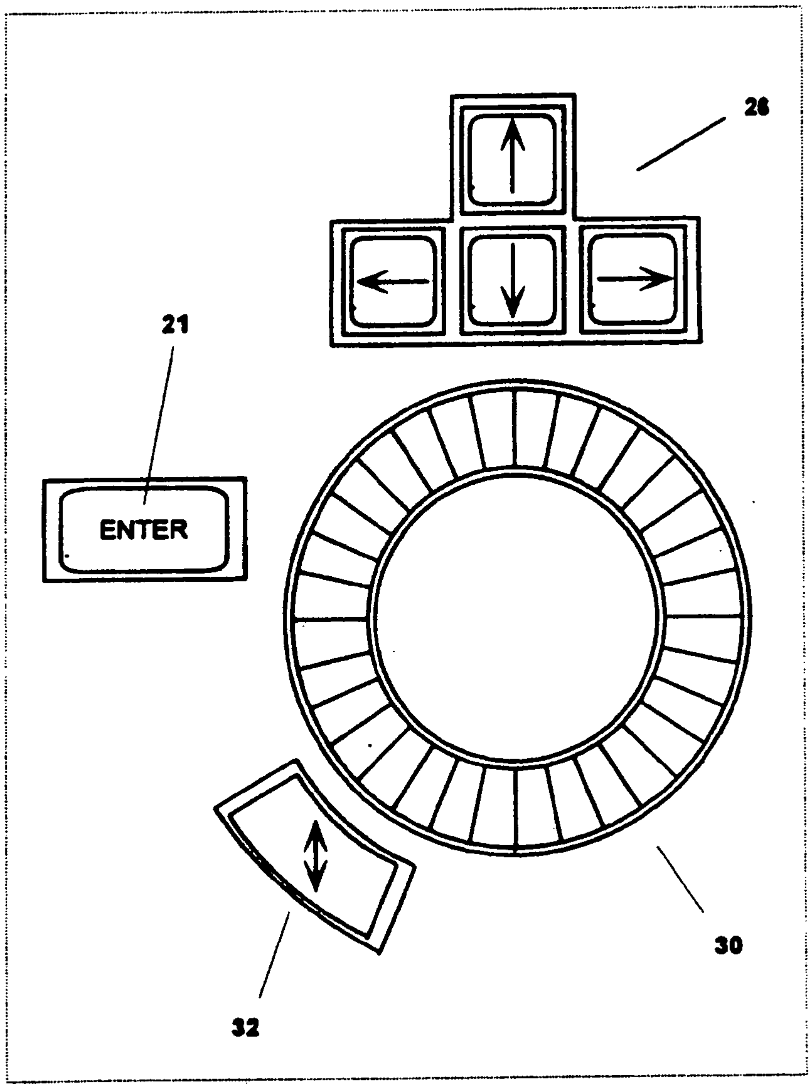

Fig. 9

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 11 3186

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
A	EP-A-0 227 387 (THE OHIO ART COMPANY) * abstract * * page 3, line 34 - line 44; figure 5 * * page 6, line 27 - line 39 * ---	1,9	G06F3/023 G06K11/18
A	EP-A-0 120 683 (TEKTRONIX) * abstract * * page 2, line 13 - page 3, line 11 * * page 9, line 6 - line 16 * -----	1,9	

TECHNICAL FIELDS SEARCHED (Int.Cl.5)

G06F
G06K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	30 December 1993	Bravo, P

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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